

A new species of rainfrog of the *Eleutherodactylus cruentus* group from eastern Honduras (Amphibia: Anura: Leptodactylidae)

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Abstract.—A new species of *Eleutherodactylus* (*E. operosus*) of the *E. cruentus* group is described from eastern Honduras. The new species differs from the remaining species in this group by the following combination of characters: heels with one small pustular tubercle; outer tarsus smooth; tubercles absent on upper eyelids; discs of fingers III–IV narrower than tympanum; disc covers and pads on fingers III–IV and all toes somewhat truncated; tympanum distinct in females; loreal region long; vomerine teeth present; dorsal surfaces brown in life; groin mottled, without distinct spots; groin and anterior and ventral surfaces of thighs brown in life; and heels pale copper in life. The forests around the known locality for the new species are under heavy human assault, even though the region is part of the Río Plátano Biosphere Reserve.

Frogs of the genus *Eleutherodactylus* (s.l.) constitute the largest genus of vertebrates with about 600 valid species currently recognized. The genus has an extensive geographic range from Arizona, U.S.A., to southern Ecuador on the Pacific slope and from Texas, USA, to Bolivia and southern Brazil on the Atlantic slope, including the West Indies.

Most mainland species belong to one of two lineages (Lynch 1986, Savage 1987), the Middle American clade (I; *Craugastor*) or the South American clade (II; *Eleutherodactylus* s.s.). These two groups are recognized on the basis of distinctive synapomorphies in the jaw muscles (Lynch 1986, Savage 1987) and karyotypes (DeWeese 1976, Savage 1987).

The majority of species found in North and Central America belong to clade I, but 14 forms, mostly confined to lower Central America, are representatives of clade II. Within that clade, twelve Central American species, characterized externally by having strongly areolate ventral integument, no toe

webs, and toe III much shorter than toe V, with the tip of the latter reaching the level of the distal subarticular tubercle on toe IV, may be referred to the *Eleutherodactylus martinicensis* series (Lynch & Duellman 1997). Prior to the present report only one member of this series, *E. ridens*, was known to range as far north as Honduras.

In July 1997, JRM and LDW collected a single subadult female *Eleutherodactylus* sharing the ventral skin texture and toe features of the *E. martinicensis* series during three nights of searching the environs of a small stream in northeastern Olancho, Honduras. This specimen differed significantly from *E. ridens* in several characters and appeared to represent an undescribed species. Thus, in July–August 1998, JRM and LDW returned to the same stream hoping to collect additional material of this *Eleutherodactylus*. Despite six nights of searching along a broader area of the stream and surrounding forest, JRM and LDW were able to secure only one additional subadult female of this form. The second specimen



Fig. 1. Subadult female holotype of *Eleutherodactylus operosus* (USNM 530555), SVL 18.8 mm.

agrees in all details with the first specimen and both differ significantly from all known Central American species of the *E. martinicensis* series. Given the difficulty in collecting these frogs, plus the fact that JRM and LDW are extremely unlikely to ever return to this rapidly deforested locality, we describe the new taxon herein.

Materials and Methods

Measurements were made to the nearest 0.1 mm with dial calipers under a dissecting microscope. Comparative material examined is listed in Appendix I. Comparative data for *E. museous* was taken from Ibáñez et al. (1994). Abbreviations used are EL (eye length), EN (anterior border of eye to posterior edge of nostril; equals loreal length), HL (head length; tip of snout to angle of jaw), HW (greatest width of head), SHL (shank length), SL (snout length; anterior border of eye to tip of snout), SVL (snout-vent-length), and TPL (tympanum length). Disc terminology follows that of Savage (1987, 1997) and color codes are

those of Smithe (1975–1981). Museum abbreviations follow those of Leviton et al. (1985), except for CRE (Costa Rican Expeditions, presently being catalogued into the LACM collection).

Systematics

Eleutherodactylus operosus, new species

Fig. 1

Holotype.—National Museum of Natural History (USNM) 530555, a subadult female, from near a small dam along a small tributary of the Quebrada de Las Márias (15°18'N, 85°21'W), about 12 airline km NNE La Colonia, Departamento de Olancho, Honduras, 680 m elev., collected 31 Jul 1998 by J. R. McCranie, K. L. Williams, and L. D. Wilson. Original number LDW 11354.

Paratype.—USNM 530556, a subadult female with the same data as the holotype, except collected 31 Jul 1997 by J. R. McCranie and L. D. Wilson.

Diagnosis.—*Eleutherodactylus opero-*

sus is referred to the *E. cruentus* group (sensu Savage 1980) within the *E. martinicensis* series by having large digital discs, non-triangular shaped disc pads, finger I shorter than finger II, and lacking toe webs. Eight valid Central American species (*E. altae*, *E. caryophyllaceus*, *E. cruentus*, *E. moro*, *E. museous*, *E. pardalis*, *E. ridens*, and *E. taeniatus*) belong to this group, which is a subset of the large (about 150 species) *E. unistrigatus* species group (sensu Lynch & Duellman 1997). *Eleutherodactylus operosus* differs from both *E. cruentus* and *E. museous* (character states for latter two species in parentheses) by having the heels with one small pustular tubercle (a distinct well-developed pointed tubercle), the outer tarsus smooth (two to four well-developed tubercles), no tubercles on the upper eyelids (distinct well-developed pointed tubercles), the discs of fingers III–IV narrower than the tympanum length (broader than tympanum length), and the groin region lacking distinct spots (usually one to several distinct yellow spots in *E. cruentus*; a black spot in *E. museous*). *Eleutherodactylus operosus* differs from *E. altae* and *E. pardalis* in having an essentially brown ground color with darker markings (nearly uniformly black), the groin area mottled dark brown and pale brown (groin marked with a large pale spot; spot red in life in *E. altae*, silvery-white in life in *E. pardalis*), and the anterior thigh surface dark brown with some pale brown mottling (marked with dark vertical bars separating large pale areas of the same color as spots in groin). *Eleutherodactylus operosus* differs from *E. caryophyllaceus* by lacking a superciliary tubercle (enlarged pointed superciliary tubercle located on free margin of upper eyelid) and by having the heel with one small pustular tubercle (distinct well-developed pointed tubercle). *Eleutherodactylus operosus* is distinguished from *E. moro* by having brown dorsal surfaces in life (green), the heels pale copper in life (no red on hind limbs), and the disc covers and

pads on fingers III–IV and all toes somewhat truncated (round). *Eleutherodactylus operosus* is distinguished from *E. ridens* by having the disc covers somewhat truncate (round), the heel with one small pustular tubercle (heels smooth to rugose), the upper eyelids smooth or rugose (one to several low tubercles), the groin and anterior and ventral surfaces of the thighs brown in life (these surfaces some shade of red in life), ventral surfaces of head and body with sparse brown flecking from chin to anterior portion of belly (ventral surfaces moderately to heavily flecked with brown), and a long loreal region (EN/EL >1.00 versus <0.90 in females). The new form differs from *E. taeniatus* in having the posterior surface of the thighs dark brown with small distinct pale spots (essentially uniformly pale brown), a smaller tympanum (TPL/EL 0.30–0.31 versus 0.45–0.48 in females), and a longer loreal region (EN/EL 1.04–1.09 versus 0.88–1.00 in females).

Description of holotype (stored in alcohol after formalin fixation).—A subadult female with the following measurements (percentages of SVL in parentheses): SVL 18.8 mm; HL 7.7 mm (41.0); HW 6.7 mm (35.6); EL 2.2 mm (11.7); SL 3.4 mm (18.1); EN 2.4 mm (12.8); TPL 0.7 mm (3.7); SHL 11.3 mm (60.1); and FL 8.1 mm (43.1). Snout long, nearly rounded in dorsal aspect, vertical with rounded upper end in profile; top of head flat; canthus rounded, distinct; loreal region concave; upper lip not flared; nostrils directed laterally, situated at point about two-thirds distance between anterior border of eye and tip of snout; cranial crests absent; supratympanic fold weak, narrowly obscuring upper edge of tympanum; tympanum indistinct, located posterior to lower half of eye, separated from eye by distance about equal to tympanum length; upper arm more slender than moderately slender forearm; transverse dermal fold present on upper surface of wrist; transverse dermal fold absent on elbow; tubercles or dermal

ridge absent along posterior ventrolateral edge of forearm; finger discs strongly expanded (disc on finger III about 3.0 times width of digit just proximal to disc); disc covers on fingers somewhat truncated; disc pads on fingers truncate; subarticular tubercles on fingers round, conical to pungent; supernumerary tubercles absent on fingers; palmar tubercle low, bifid, larger than thenar tubercle; 3–4 accessory palmar tubercles present; thenar tubercle ovoid to elongate, elevated, barely visible from above; pollex not enlarged; relative length of fingers $I < II < IV < III$; fingers unwebbed, bearing weak lateral keels on fingers II–IV; heels broadly overlapping when hind limbs held at right angles to body; weak vertical dermal fold present on outer lateral edge of heel; heels bearing a single, small pustular tubercle; tubercles or dermal ridge absent along posterior ventrolateral edge of tarsus; inner tarsal fold absent, although one low elongated tubercle present on one leg at about one-third length of tarsus; subarticular tubercles on toes round, globular; supernumerary tubercles absent on toes; 8–10 very small plantar tubercles present; inner metatarsal tubercle elongate, elevated, visible from above; outer metatarsal tubercle absent; relative length of toes $I < II < III < V < IV$, disc on toe V extending to level of distal subarticular tubercle on toe IV; toe discs moderately expanded (disc on toe IV about 2.5 times width of digit just proximal to disc); disc covers on toes somewhat truncated; disc pads on toes somewhat truncated; toes unwebbed, bearing very weak lateral keels; inguinal gland not evident; vent opening directed posteroventrally near upper level of thighs, skin below vent granular; skin of dorsal surfaces smooth to weakly granular, including that of upper eyelids; distinct ridge extending posteriorly from upper eyelids to level above axilla, ridge broken posteriorly with small laterally offset portion just posterior to level of axilla; suprascapular fold absent; dorsolateral ridges absent; skin of

throat, chest, and ventral surface of thighs smooth, that of belly coarsely areolate; ventral disc absent; pupil horizontally elliptical; palpebral membrane translucent, unpatterned; tongue ovoid, barely notched posteriorly, free posteriorly for about one-half of its length; vomerine teeth on very low, ovoid ridges located posteromedially to ovoid choanae, tooth patches separated by distance greater than width of either patch; maxillary teeth present.

Color in life: dorsal surfaces of head and body Hair Brown (119A), with raised Mahogany Red (132B) postocular ridge; dorsal surface of forelimbs Hair Brown (119A); dorsal surface of hind limbs Army Brown (219B), with Sepia (219) crossbars; heels pale copper; groin mottled Hair Brown (119A) and Army Brown (219B); chin transparent with small brown punctations; belly colorless with small white punctations; iris yellowish brown on upper half, bronze with brown reticulations on lower half.

Color in alcohol: dorsal surfaces of head and body brown with darker brown outlining postocular ridge; dorsal surfaces of limbs pale brown with distinct, dark brown crossbars; lateral surface of head barred with pale brown and dark brown; posterior surface of thighs dark brown, with distinct pale brown spots; anterior surface of thighs dark brown, with some pale brown mottling; heel region very pale brown; ventral surfaces of head, body, and thighs pale cream-colored, with sparse brown flecking from chin to anterior portion of belly, flecking more pronounced on thighs.

Variation in paratype.—The paratype agrees well with the holotype in all morphological characters and in color pattern, except that the heel tubercles are not as well developed and the vomerine tooth patches are better developed than in the holotype. The following measurements (percentages of SVL in parentheses) were recorded: SVL 20.2 mm; HL 8.1 mm (40.1); HW 6.8 mm (33.7); EL 2.6 mm (12.9); SL 3.8 mm (18.8); EN 2.7 mm (13.4); TPL 0.8 mm

(4.0); SHL 11.9 (58.9); and FL 8.6 mm (42.6).

Natural history notes.—Both specimens were taken at night from vegetation about 1.5 m above the ground along a trail near where it crosses a small stream at 680 m elevation. Although the specimens were taken in different years, both were found at nearly the identical spot along the trail. The locality is in the Premontane Wet Forest formation of Holdridge (1967). The vegetation in the immediate vicinity was in a nearly pristine condition in 1997 and 1998. However, the area alongside this stream was completely deforested at 660 m, as were most of the hillsides surrounding the forest on both sides of the portion of the stream where *E. operosus* was collected. Also, considerably more deforestation was evident along this stream on JRM's and LDW's second trip in 1998 than was evident in 1997. This extensive deforestation is occurring even though the region is part of the "protected" Río Plátano Biosphere Reserve. Other species of *Eleutherodactylus* collected in the environs of this trail and stream were *E. epochthidius*, *E. fitzingeri*, *E. mimus*, *E. ridens*, and *Eleutherodactylus* sp. (*E. rugulosus* group). Males of *E. fitzingeri* and *E. ridens* could be located by their advertisement call. No other species of *Eleutherodactylus* were heard to call at this locality.

Etymology.—The name *operosus* is a Latin word meaning laborious or difficult (Brown 1991). The name is used in reference to the difficulty experienced in efforts to collect a series of these frogs.

Remarks.—Lynch & Duellman (1997) referred all species in the *E. martinicensis* series to two subdivisions, the *E. diastema* group (now composed of seven species, Savage 1997) and the *E. unistrigatus* group (about 150 species). It is clear that the latter is a composite that will be further divided into additional species groups as knowledge increases. The species placed here in the *E. cruentus* group are the same as those included by Savage (1980), with the exclu-

sion of *E. cerasinus*, transferred by Lynch & Duellman (1997) to the *E. conspicillatus* series, and the additions of *E. museous*, *E. operosus*, and *E. taeniatus*. It remains to be seen if the *E. cruentus* group, as utilized here, is monophyletic, but for the present it conveniently clusters all Central American species of the *E. martinicensis* series, aside from *E. diastema* and its allies, belonging to the South American clade into a single group.

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Appendix I

Comparative Material Examined

Eleutherodactylus altae. Costa Rica—San José: CRE 3181, 3212, 3380–81, 7048.

Eleutherodactylus caryophyllaceus. Costa Rica—Cartago: CRE 7053, 7058 (2), 7060, 7075, 7095. San José: CRE 7035, 7048.

Eleutherodactylus cruentus. Costa Rica—Alajuela: CRE 693, 696, 767, 2929, 2932, 7014. Cartago: CRE 191, 2284. San José: CRE 490, 3181, 6467–68.

Eleutherodactylus moro. Costa Rica—San José: CRE 765, UCR 6000.

Eleutherodactylus pardalis. Costa Rica—Puntarenas: CRE 916 (2), 919, 3182 (2), 3485, 3488, 7224, LACM 119586. San José: CRE 7097.

Eleutherodactylus ridens. Honduras—Atlántida: FMNH 236380, SMF 77632–33, USNM 514529–50. Colón: BMNH 1985.1232, 1985.1453, LSUMZ 33647, UMMZ 89461, USNM 514551–54. Olancho: SMF 78781–82, USNM 343720–22, 344791, 514555–59, 530557–60.

Eleutherodactylus taeniatus. Colombia—Chocó: LACM 50551, 73208, 73212, 73222–23.